

## REMARKS/ARGUMENTS

Claims 3-21 are currently pending in the present patent application, with claims 1, 2 and 22-37 having been withdrawn in an Office Action mailed 4 April 2006.

In the Office Action, the Examiner acknowledges receipt of a priority document associated with applicant's priority claim under 35 U.S.C. § 119(a)-(d) but notes that no translation of the priority document had been filed as of the date of the Office Action. Because there was no translation of the priority document provided, the Examiner indicates that he can not determine whether the priority document fully supports the claimed subject matter and indicates that, in the absence of such a translation, priority for the elected claims in the present application is granted only as of the filing date of the present application, namely 19 June 2003.

The present application claims priority from European Patent Application No. 02425408.8 filed on 20 June 2002. European Patent Application No. EP1376606A1 was published in English on 2 January 2004, and this published application is based upon the same 02425408.8 application as the present application. A copy of this published English translation accompanies this amendment and is an accurate translation of the previously submitted certified copy of the priority document for the present application. Accordingly, examination of the present application should proceed on the basis of a 20 June 2002 priority date.

In the Office Action, the Examiner rejected claims 3-21 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. With regard to claim 3 the Examiner indicates this claim recites "using" DNA strands and "using" carbon nanotubes while claim 5 recites "using" DNA strands and claim 10 recites "using" a functional group. The Examiner states that it is unclear what active method step or steps are intended to be encompassed by the term "using" recited in these claims, and therefore concludes that claims 3, 5, and 10 are indefinite. Claims 4 and 6-21 depend from claims 3 and 5 and are therefore also deemed indefinite.

The "use of DNA strands" in line 3 and "use of carbon nanotubes" in line 4 of claim 3 are introduced in paragraph 68 and subsequent paragraphs of the present application, and are explained with reference to Figures 14-19 of the present application. From these paragraphs and figures, one skilled in the art will understand that the term "using" is

directed to a method and structure where a memory architecture is fabricated by assembling memory elements formed by “DNA strands” and connection elements formed from carbon nanotubes for connecting to the memory elements. Paragraph 68 expressly recites that a nonvolatile memory according to an embodiment of the present invention is obtained using a set of DNA strand molecular switches, the addressing of which is controlled by means of molecular wires constituted by carbon nanotubes. Figure 7 shows a plurality of nanoelectrodes 2 and 3 formed on a substrate 1, with a catalyst then being deposited on nanoelectrodes 3 as shown in Figure 8 so that carbon nanotubes can be formed between these electrodes, as illustrated in Figure 9. DNA strands 12 are then formed between the nanoelectrodes 2 and the carbon nanotubes 5 as illustrated in Figure 19. Thus, the DNA strands 12 are used as memory elements and the carbon nanotubes 5 are used for interconnection to the DNA strands, as discussed in detail with reference to Figures 7-19, for example.

For these reasons, claim 3 satisfies the second paragraph of Section 112 and this rejection should be withdrawn.

Regarding claim 4, the Examiner states that this claim recites “hybridizing ... DNA strands” but does not recite what they are hybridized to, i.e., each other, a strand from another device, etc. The Examiner concludes the intended “partner” in the hybridization step is unclear and therefore the claim indefinite.

The concept of DNA hybridization is understood by those skilled in the art. One skilled in the art will appreciate that every DNA single strand can be hybridized to form a double strand DNA elica only with its complementary single strand (*i.e.* containing the exact sequence of oligonucleotides matching the well-known complementary sets of Adenine(A)-Timine(T) and Citosine(C)-Guanine(G), such as *e.g.*, a DNA composed by CAGTC only hybridizes with its complementary sequence GTCAG. Claim 4 recites the method of claim 3 further including “hybridizing said DNA strands for storing information in said memory elements.” A single DNA strand, namely a DNA strand not hybridized with the complementary chain, has a different electrical conductivity with respect to a double DNA strand, namely a DNA strand hybridized with its complementary chain. This is clearly discussed in paragraphs 71-76, for example. See also paragraphs 106-113. Paragraph 71 in particular makes clear the concept of hybridization of DNA as will be understood by those skilled in the art.

For these reasons, claim 4 satisfies the second paragraph of Section 112 and this rejection should be withdrawn.

Claim 5 recites further details for “making memory elements using DNA strands” and “making connection elements using carbon nanotubes” as recited in claim 3. The elements set forth in claim 5 will be understood by those skilled in the art with reference to the embodiments discussed in Figures 7-9 and 14-19 and the associated description in the specification. The elements “forming an array of first nanoelectrodes on a substrate of insulating material” and “forming on said substrate a plurality of carbon nanotubes” are described with reference to Figures 7-9, and the “functionalizing said nanotubes so that they are suitable for making contacts with DNA strands is discussed with reference to Figures 10-12. The “contacting said first nanoelectrodes and said nanotubes using DNA strands” is discussed with reference to Figures 16 and 17, for example, and the “hybridizing or not hybridizing said DNA strands according to the information that is to be stored” is discussed with reference to Figures 15 and 16.

With regard to the recited “hybridizing or not hybridizing” element, this element is directed to the ability to control the hybridization or not of every single memory element (*i.e.*, DNA strand) by selecting complementary chains only related to the memory elements that have been selected for storing the information corresponding to the hybridized chains (*i.e.* the memory elements of the memory that are selected to be set up (or written) and which will therefore have high conductivity values. In contrast, those memory elements that are selected to be set up or “not written” will not be hybridized and accordingly will have low conductivity values. All other boundary conditions, such as temperature, DNA length, etc. affecting the hybridization are maintained and engineered *a priori* as known in the art. This concept will be understood by one skilled in the art from the description in the present application. See, *e.g.*, paragraphs 82 *et seq.* and 83, for example, of the present application. See, *e.g.*, [0082] and [0083]. Moreover, original claims 18 and 19 recite selectively hybridizing said DNA strands to write the logic state “1” and not hybridizing said DNA strands to write the logic state “0”, which further illustrate the use of the terms hybridizing and not hybridizing as used in the context of the present application.

For these reasons, claim 5 satisfies the second paragraph of Section 112 and this rejection should be withdrawn.

The Examiner rejected claim 8 under Section 112 for the phrase “making use of a manipulator,” indicating that it is unclear what step or steps are to be performed with such manipulator and therefore rendering the claim indefinite. Claim 8 recites an option for forming a plurality of carbon nanotubes in the substrate as recited in claim 5 using a manipulator as a nanopositioning tool. Thus approach is a possible alternative to other methods for forming the carbon nanotubes, such as the ones recited in claims 6 and 7, and as described in paragraphs 83-93, for example. From this discussion generally and paragraph 90 in particular, one skilled in the art will understand “making use of a manipulator” set forth in claim 8 as being directed generally to one method of forming the carbon nanotubes.

For these reasons, claim 8 satisfies the second paragraph of Section 112 and this rejection should be withdrawn.

With regard to the Examiner’ rejection of claim 10 under Section 112, claim 10 recites “using a functional group” in the sense of the procedure being used in the functionalization of the nanotubes. See paragraphs 93 and 94 and Figures 10-12, for example. Claim 10 satisfies Section 112 and this rejection should be withdrawn.

Claim 11 recites a method to functionalize the carbon nanotubes with a well known benzyne group ( $C_6H_4$ ) or a derivative group from Benzyne, *i.e.* a benzyne group terminated with an alchyl chain ( $C_6H_3-R$ ). See paragraphs 94-97 which explain the reaction behind so called cycloaddition. Figure 11 is a schematic illustration of the way in which the nanotubes are functionalized and show more details obtained by simulation of the cycloaddition reaction and distribution of binding electrons that can be obtained. Claim 11 satisfies Section 112 and this rejection should be withdrawn.

With regard to claim 13, the Examiner states the claim limits functionalization to “be performed locally: and says it is unclear what is intended to be local on a nanotube. The concept of performing functionalization of carbon nanotubes locally is clearly described in detail in paragraphs 93-96 and with reference to Figure 12. The use of term “locally” is intended in the same way as it is used commonly in the state of the art of nanomanipulation techniques applied to organic molecules and carbon nanotubes. It is known, for instance, that the concept of local oxidation performed by Deep Pen Nanolithography (DPN) tools in molecular structures or the concept of local interaction with molecular arrays arranged on surfaces that is actuated by Atomic Force Microscopy (AFM)

or Scanning Tunneling Microscopy (STM) tools. One skilled in the art will understand claim 13 and thus this claim satisfies Section 112.

Dependent claims 17, 20 and 21 have been amended to depend from claim 5 to eliminate any antecedent basis problems in these claims. With regard to claim 21, reference to the so called “amide bond” –CONH- group will be clear to one skilled in the art in view of the description in paragraph 109 and Figure 17. The meaning of word “contacting” should be clear from the context and also detailed in paragraph 109 with reference to Figures 17 and 18. Claims 17, 20, and 21 satisfy Section 112.

In the Office Action, the Examiner rejected claims 3 and 17 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,486,489 to Watanabe *et al.* (“Watanabe”).

Claim 3 recites a method for manufacturing a memory device including the step of creating a molecular memory that includes making memory elements using DNA strands and making connection elements using carbon nanotubes for connecting the memory elements. Figure 19 illustrates a sample embodiment covered by claim 3.

In contrast to claim 3, Watanabe is directed not to a memory device but to a field effect transistor including DNA material used as the channel for the transistor. There is simply no disclosure nor suggestion in Watanabe of making a memory using DNA strands. Instead, in Watanabe DNA is used to form the channel of a field effect transistor so the working principle is the field effect modulation of the current flow through the channel. Although a nanotube is considered in Watanabe, this is merely in the context of a transistor. There is no suggestion or disclosure in Watanabe to use DNA strands to store a logic “0” or a logic “1”, corresponding to not hybridized and hybridized DNA strands, respectively.

For these reasons, the combination of elements recited in claim 3 is allowable. Dependent claim 17 is allowable for at least the same reasons as claim 3 and due to the additional limitations added by this claim.

In the Office Action, the Examiner also rejected claims 3-9, 13-14, and 16-19 under Section 102(e) as being anticipated by U.S. Patent No. 6,958,216 to Kelley *et al.* (“Kelley”). Kelley relates to carbon chemical and biological sensor devices formed by an array of CNTs grown on a catalyst material and to which biological molecules are attached. The devices are used as sensor resistors, namely a device that changes its conductivity as a

consequence of the presence of bio-molecules. There is no disclosure or suggestion of using these sensors as memory elements. The DNA strands recited in claim 3 are used as memory elements and have resistances that do not vary as a function of bio-molecules, but instead have programmed resistances or conductivities to store either a logic 0 or 1 value.

For these reasons, Kelley neither discloses nor suggests the combination of elements recited in claim 1 and claim 3 is accordingly allowable. Dependent claims 4-9, 13-14, and 16-19 are allowable for at least the same reasons as claim 3 and due to the additional limitations added by each of these claims.

In the Office Action, the Examiner rejected claims 10, 15, and 20 under 35 U.S.C. § 103(a) as being unpatentable over Kelley as applied to claims 3-9, 13-14, and 16-19.

Kelley does not at all relate to memory devices, but instead to a device made only and specifically for the purpose of a molecular sensor device. There is accordingly no motivation, suggestion, or teaching that to modify the teachings of Kelley to achieve the combinations of elements set forth in claims 10, 15, and 20.

Claims 11 and 12 were rejected by the Examiner under Section 103(a) as being unpatentable over Kelley and further in view of a reference to Bradsher. As set forth above, there is simply no motivation, suggestion, or teaching to modify Kelley to form a memory device. Kelley is directed to forming sensors using DNA and not to using such DNA as memory elements. Claims 11 and 12 are not obvious in view of Kelley and Bradsher and are in condition for allowance.

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The present patent application is in condition for allowance. Favorable consideration and a Notice of Allowance are respectfully requested. Should the Examiner have any further questions about the application, Applicant respectfully requests the Examiner to contact the undersigned attorney at (425) 455-5575 to arrange for a telephone interview to resolve the matter. If the need for any fee in addition to that paid with this response is found, for any reason or at any point during the prosecution of this application, kindly consider this a petition therefore and charge any necessary fees to Deposit Account 07-1897.

Respectfully submitted,

GRAYBEAL JACKSON HALEY LLP

A handwritten signature in black ink, appearing to read "Paul F. Rusyn".

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Paul F. Rusyn  
Registration No. 42,118  
155 – 108<sup>th</sup> Avenue NE, Suite 350  
Bellevue, WA 98004-5973  
(425) 455-5575 Phone  
(425) 455-5575 Fax